Canadian Patents Database

03/08/2002 - 23:34:18

(12) Patent: (11) CA 00873854

(54) SEPARATION CELL AND SCAVENGER CELL FROTHS TREATMENT

(54)

View or Download Images

---

(72) Inventors (Country): ROBERT A. BAILLIE (Not Available)

(73) Owners (Country): GREAT CANADIAN OIL SANDS

(71) Applicants (Country):

(74) Agent:

(45) Issued on: June 22, 1971

(22) Filed on:

(43) Laid open on:

(52) Canadian Class (CPC): 196/23

(51) International Class (IPC): N/A

Patent Cooperation Treaty (PCT): No

(30) Application priority data: None

Availability of licence: N/A

Language of filing: **Unknown**

ABSTRACT:

CLAIMS: Show all claims

*** Note: Data on abstracts and claims is shown in the official language in which it was submitted.

View or Download Images :

- ⦿ Cover Page Image
- O Abstract Image
- O Claims Image
- O Disclosures Image
- O Drawings Image

View the Image
Download in Adobe PDF

Top of Page

Tar sands which are also known as oil sands and bituminous sands are aggregates of sand, clay, oil and water impregnated with heavy petroleum. The largest and most important deposits of the sands are the Athabasca sands, found in northern Alberta, Canada. These sands underlay more than 13,000 square miles at depths of 0 to 2,000 feet. Total recoverable reserves after extraction and processing are estimated at more than 300 billion barrels--just about equal to the world-wide reserves of conventional oil, sixty percent of which is in the Middle East. By way of comparison, the American Petroleum Institute estimated total United States oil reserves at the end of 1965 at 39.4 billion barrels.

The tar sands are primarily silica, having closely associated therewith an oil film. This oil varies from about 5 percent to 21 percent by weight, with a typical content of 13 weight percent of the total material. The oil is quite viscous--6° to 8° API gravity--and contains typically 4.5 percent sulfur and 38 percent aromatics.

In addition to oil and sand, the composition of the sands includes clay and silt in quantities of from about 1 to 50 weight percent, more usually 10 to 30 percent and a small amount of water in quantities of 1 to 10 percent by weight.

Several basic extraction methods have been known for many years for the separation of oil from the sands. In the so-called "cold water" method, the separation is accomplished by mixing the sands with a solvent capable of dissolving the bitumen constituent. The mixture is then introduced into a large volume of water, water with a surface agent added, or a solution of a neutral salt in water. The combined mass is then subjected to a pressure or gravity separation.

*

In the hot water method, the bituminous sands are jetted with steam and mulled with a minor amount of hot water at temperatures in the range of about 140° to 210°F. The resulting pulp is dropped into a turbulent stream of circulating hot water and carried to a separation cell maintained at a temperature of about 150° to 200°F. In the separation cell, sand settles to the bottom as tailings and oil rises to the top in the form of a froth. An aqueous middlings layer containing some mineral and bitumen is formed between these layers. A scavenger step can be conducted on this middlings layer to recover additional bitumen therefrom. This step usually comprises aerating the middlings as taught by K. A. Clark, "The Hot Water Washing Method," Canadian Oil and Gas Industries 3, 46 (1950).

The present invention is directed to an improvement in the above-described hot water process and more specifically is directed to a process for treating the separation cell and scavenger cell froths. The invention is based on the discovery that the respective froths are different both in composition and in the nature of the composition and may be therefore most advantageously treated by separate processes.

In one embodiment the invention may be considered an improvement in the process disclosed and claimed in the copending Dobson Canadian application Serial No. 003,884 filed concurrently. That application claims a method for treating the froths from the hot water process by settling the scavenger cell froth, then combining the primary froth with the overflow bitumen layer from the scavenger froth settling operation. The combined bitumens are then treated together by chemical settling,

centrifuging or other techniques for removing residual air, water, and mineral. By the present invention, after the secondary froth is settled to produce an overflow bitumen layer, the layer is removed from the settling zone and is centrifuged to give a bitumen product which is added to a bitumen product from the primary separation zone froth. This latter bitumen product has been recovered from the primary froth by dilution and settling.

Conventionally bitumen froth recovered in the separation cell is combined with the froth from the air flotation scavenger cell prior to treatment to resolve the froth emulsions. In this treatment process, which involves chemical treating to break oil-water emulsions, relatively large quantities of bitumen and diluent, up to 25 percent of feed hydrocarbons, are lost to the water-rich tailings stream. The lost hydrocarbon particles exhibit an apparent density equal to or greater than that of water, and so, do not float. Since analyses indicate that the tailings hydrocarbon is essentially identical to overhead product, there is a strong inference that attached mineral causes the increased particle density and thus prohibits flotation.

It is thought that this bitumen of increased apparent density comes mainly from that from the scavenger cell froth since this bitumen did not float as a froth in the primary separation cell but was recovered from the middlings only by subsequent air flotation. The necessity of air flotation for froth formation from this bitumen indicates that even in the primary separation, this material exhibits a higher apparent density relative to the density of the bitumen in the primary froth. This higher density appears to be due to associated mineral in the scavenger bitumen.

By the present invention the scavenger froth is processed through a centrifuge operation to remove mineral by the application of high settling forces. This centrifuging operation is most advantageously a two-stage process. The centrifuging step may be combined with a preliminary settling step such as that disclosed and claimed in the Dobson Canadian application, Serial No. 003,884.

The primary separation cell froth need not be treated as violently as the scavenger cell product because it does not contain as much associated mineral. By the present invention the primary froth is diluted and settled in a settling zone. In this step chemical treatment may or may not be used to aid in breaking the emulsion. Such processes and variations thereof are disclosed in U. S. Patent No. 3,130,142, Nathan et al. and U. S. Patent No. 2,825,677, Coulson. In this settling, any mineral, which is mainly trapped in the emulsion, is removed when the emulsion is broken by chemical treating.

In one embodiment of the present invention, the froths are treated as follows:

The primary froth from the separation zone is diluted with a hydrocarbon diluent and, if necessary, treated with an emulsion breaking reagent. The hydrocarbon diluent is miscible with the bitumen in the primary froth and is capable of lowering its specific gravity. The diluted and treated froth is then settled in a settling zone where it forms into a lower underflow layer comprising sand, mineral and water and an upper overflow layer comprising bitumen and diluent containing some residual water and mineral.

While the primary froth is undergoing the procedure described, the secondary froth from the middlings scavenger

operation is settled in a settling zone to form a lower underflow of settler tailings substantially reduced in bitumen content compared to the secondary froth and an upper bitumen layer substantially upgraded in bitumen content compared to the secondary froth. This settling step need not be diluent or chemically aided. This step is disclosed and claimed by Dobson Canadian patent application Serial No. 003,884.

After the secondary froth is settled, the upper bitumen product layer is withdrawn from the settler and subjected to a centrifuging operation to recover a bitumen product stream reduced in mineral content compared to the bitumen product layer. This centrifuging operation and any of the centrifuging operations described in the invention embodiments may be of the two-stage separation type disclosed by Coulson, U. S. Patent No. 2,825,677. The bitumen-product stream from the centrifuging operation and the bitumen-diluent layer from the primary froth settling step are then combined. The resulting mixture is suitable for further processing by coking and refining or the like.

In another embodiment, the secondary froth from the scavenger step of the hot water process is subjected to a centrifuging operation without a preceding settling step. The centrifuged product is then added to the bitumen-diluent layer from the primary froth settling step for further upgrading. The material treated in the centrifuging operation in this embodiment will of course contain more mineral and water then with the other embodiments described <u>supra</u>. This, of course, will necessitate the use of different designed centrifuges, longer residence times, or other techniques to handle the higher mineral contents of the feed. This operation will therefore be more expensive than the embodiments described above, and for this reason is less preferred than the others.

A

In any of the above described embodiments in any of the settling steps any type or combination of types of settlers may be used. For example, continuous mechanical thickeners or clarifiers consisting of a single-compartment cylindrical tank or basin with a sloping bottom, a conical central area over a discharge outlet, and rotating rakes that move the settled solids toward the center of the basin might be used. Tanks may be either square or rectangular when space is limited or when a vast amount of settling area, combined with a high volume of relatively dilute flow, is required.

Also in the above described embodiments, in any of the diluting steps, any diluent may be used so long as it is a hydrocarbon capable of dissolving the bitumen constituent of the particular stream treated and of substantially lowering its specific gravity. While hydrocarbons such as benzene, xylene, toluene, gasoline, kerosene, furnace distillates, or diesel fuels, and others may be used, petroleum naphtha is the preferred diluent.

The drawing schematically illustrates the present invention. The figure shows the process utilizing settling and centrifuging of the secondary froth and settling of the primary froth.

Bituminous tar sands are fed into the system through line 1 where they first pass to a conditioning drum or muller 19. Water and steam are introduced via line 2 and mixed with the sands. The total water so introduced is a minor amount based on the weight of the tar sands processed and generally is in the range of 10 to 40 percent by weight of the mulled mixture. Mulling of the tar sands produces a pulp which then passes from

the conditioning drum as indicated by line 3 to a screen indicated at 20. The purpose of the screen 20 is to remove from the tar sands pulp any debris, rocks, or oversize lumps as indicated generally at 4.

The pulp passes from screen 20 as indicated by 5 to a pump sump 21 where it is diluted with additional fresh water from 6 and a middlings recycle stream 7. The diluted pulp is then pumped via 8 to the primary separation zone 22. The settling zone in separator 22 is relatively quiescent so that oil froth rises to the top and is withdrawn via line 9 while the sand settles to the bottom as a tailings layer which is withdrawn through line 10. A lower middlings stream is withdrawn via 7 and recycled to the pump sump for mixing with the pulp.

An upper middlings layer which contains some oil that failed to separate is withdrawn from the cell through line 13 to a flotation scavenger zone 24. In this zone an air flotation operation is conducted to cause the formation of additional oil froth which according to one embodiment passes from scavenger zone 24 through line 14 to a secondary froth settler zone 25. An oil-lean water middlings stream is removed and discarded from the bottom of scavenger zone 24 via line 15.

In the secondary froth settler zone 25, the secondary froth forms into an underflow layer of settler tails which is withdrawn through 17 and an upper overflow layer of upgraded bitumen which is withdrawn through 16 and centrifuged at 26 to remove associated mineral.

Diluent and chemical settling aids are added to the primary froth in line 9, and this froth is settled in zone 23 to form an upper overflow bitumen layer and a lower underflow layer which is removed through 11. The upper layer is then sent

via 12 to be added to the bitumen layer from the secondary froth in 18. The combined bitumens are then further upgraded.

The froth from the scavenger zone 24 may, in another embodiment of the invention, be passed directly via line 14 to the centrifuge zone 26, by-passing the preliminary settling operation at 25. After centrifuging the bitumen is added to the upper layer from the settling zone 23 as described.

The following example illustrates the invention more specifically:

The invention is utilized to recover the oil from Athabasca tar sands containing by weight about 10 percent bituminous matter and 85 percent mineral matter. On an hourly basis sufficient amount of tar sands to give 1,000 tons in the feed after screening is fed along with 300 tons of water and steam, into a conditioning drum and the mixture is heated to about 180° F. while being mulled. The resulting pulp is passed through a screen and then to a feed sump where it is mixed continuously with hot water in the amount of 740 tons per hour and with a middlings recycle stream in the amount of 2,000 tons per hour. The diluted pulp is then pumped to the separation cell wherein the temperature is maintained at 190°F. From the separator sand tailings are removed from the bottom at a rate of 800 tons per hour and froth is removed from the top at a rate of about 100 tons per hour. An oil-lean middlings layer is removed and recycled at the rate of 2,000 tons per hour. The tailings are composed of about 600 tons of sand and mineral, 190 tons of water and 10 tons bitumen on an hourly basis. The primary froth is approximately composed by weight of 50 percent bitumen, 10 percent mineral matter, and 40 percent water. The bitumen content thereof corresponds to a recovery of about 50 percent of the bitumen in the original tar sands.

A stream of oil-rich middlings in amount of 1,140 tons per hour and composed of about 40 tons of bitumen, 240 tons of mineral matter, and 860 tons of water is withdrawn from the separator and transferred to a scavenger zone wherein it is subjected to air flotation in a subaeration type air flotation cell. A secondary oil froth is obtained here and settled to give about 70 tons per hour of product. About 1,070 tons per hour of oil-lean middlings are withdrawn from the flotation cell and discarded. The secondary froth, after settling, is composed of about 50 weight percent bitumen. This settler product is processed in a solid bowl-disc two stage centrifuge combination to give a bitumen product at the rate of about 33 tons per hour. The bitumen is almost entirely free from mineral and water and may be added to bitumen-diluent product from a primary froth settling operation and further refined.

The example shows that the primary froth and scavenger cell froths may be most advantageously treated by separate processes, particularly by diluent aided settling of the primary froth and settling and centrifuging of the scavenger froth.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. In the hot water process for treating bituminous tar sands which comprises: forming a mixture of the bituminous sands and water; passing the mixture into a separation zone; settling the mixture in the separation zone to form an upper primary bitumen froth layer, a middlings layer comprising water, mineral and bitumen and a sand tailings layer; separately removing the primary bitumen froth layer and the sand tailings layer; passing a stream of middlings layer from said separation zone to a scavenger zone and therein recovering a secondary bitumen froth; the improvement which comprises:

(a) diluting said primary froth with a hydrocarbon diluent miscible with the bitumen in said primary froth and capable of lowering its specific gravity;

(b) settling said diluted froth to produce an upper overflow layer comprising bitumen-diluent and a lower underflow layer comprising sand, mineral, and water;

(c) separately removing said upper overflow bitumen-diluent layer and said lower underflow layer;

(d) subjecting said secondary bitumen froth with or without prior settling to a centrifuging operation to recover a bitumen product stream reduced in mineral content compared to said bitumen product layer;

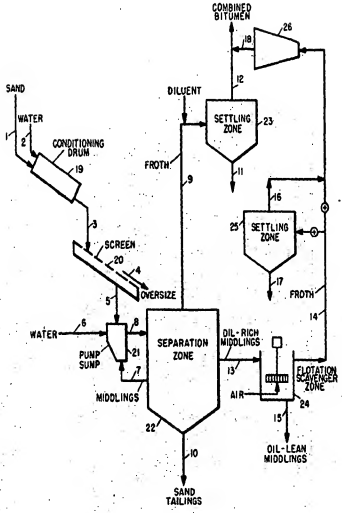
(e) removing said bitumen product stream from Step (d) and combining it with said upper overflow bitumen-diluent layer from Step (c) to form a mixture suitable for further upgrading.

2. The process of Claim 1 in which in Step (d), the secondary bitumen froth is subjected to the centrifuging operation without a prior settling step.

3. The process of Claim 1 in which the secondary bitumen froth is settled to form a bitumen product layer which is then subjected to the said centrifuging operation of Step (d).

4. The process of Claim 2 in which Step (d) comprises centrifuging the bitumen froth in two separate steps.

5. The process of Claim 3 in which Step (d) comprises centrifuging the bitumen product layer in two separate steps.



LIE

T AGENT

MacTavish

& Henderson